

THE MINES OF ARIZONA

This department is under the direction of Mr. W. E. Defty, who will carefully scrutinize all matters relating to mining in order that only reliable information regarding legitimate enterprises shall find a place here.

The Republic would be pleased to receive information from any part of the state regarding the development of the mining industry. All communications should be addressed: Mining Department, Arizona Republican.

From the Annual Report of the National Bureau of Mines, Joseph A. Holmes, Director

During the past several years development in the metal-mining industries of the western states has fallen far short of that of agriculture. In some of these states there has been a decline rather than an advance in mining development. Thus, in the states of Colorado, Idaho and Montana—the only states for which we have such records—the average number of men employed in the metal-mining industries for the five years ended December 31, 1912, is but 69 per cent of the average number of men employed during the five years ended December 31, 1907. The total number of men in those industries in these three states was 61,167 in 1909, and only 28,461 in 1912.

During this time, furthermore, there has been little advance in the annual values of mineral products. Meanwhile, however, agriculture in these western states has had the advantage of an agricultural experiment station and an agricultural school established and maintained by the federal government in each state; and it has also had the advantage of the expenditure of approximately \$92,000,000 since 1902 in the irrigation and development of large areas of public lands in each state.

As a means of carrying forward the needed investigations looking to the upbuilding of the mining industry in the public-land states, it will be highly advantageous either that a considerable number of mining experiment stations be established in those states, or that additional funds be provided to enable the bureau of mines to conduct such

general investigations in those states as is believed will aid in a better development of the metal-mining industries of the country.

Cheap Copper

While the Warren district at Bisbee boasts the highest grade copper ore in the world, Arizona is not afraid of low grade ore and has mountains of it. Some of the mines out there are building smelters on 2½ per cent. propositions, and are making fortunes at that.

A Lucky Strike

Twelve years ago a rancher who was struck with the levelness of the land at one point in Cochise county, Arizona, tried to dig a well there. He struck artesian water and bragged about it. The big operating companies at Bisbee knew the limits of their own water supplies and their possible development, so they moved their smelters down to the man's ranch and named it Douglas. It is now a city of 12,000 inhabitants with two of the biggest smelters in the world and water for all the industries that can accumulate.—Los Angeles Times.

Magma

Mr. J. J. Neary who has been superintendent of this property ever since the Gun, Thompson interests acquired it, has tendered his resignation, the same to take effect today. Mr. Neary has applied himself assiduously to his work and certainly merits a well earned rest.

The Magma property is now receiving its electrical power from Roosevelt. The pumps of the mine were started upon the power a week ago. All the offices are also lit up with electricity.

This is an important installation the length of the line is 45 miles carried straight across the country. There are many miles of broad side hill trail through the mountains. This work was mainly constructed by Indians and is an excellent job, and it is expected to turn some of this trail into a wagon road. All the towers of the transmission line are of steel with cement foundations. All the work is of a very substantial and permanent nature.

Copper—Strength of Metal's Position

If with spelter under 5 cents per pound and steel prices at the lowest figures for years, copper prices can be maintained at 14 cents and above, with the brass industry in this country operating 60 per cent and new construction practically stopped, it is a wonderful commentary on the world-wide demand for the metal. The question to be considered is at what price copper will sell with business even normal, let alone booming.

A production of 151,000,000 pounds of copper for the month of April was a surprise, and under the circumstances an increase of 7,000,000 pounds was most satisfactory, following a decrease of 9,000,000 pounds the previous month. We are now back to practically normal copper production in this country, and at the moment it may be that production is slightly in excess of consumption, but this is not a situation to cause much worry, for with the slightest sign of business improvement in this country the demand for copper here would increase by leaps and bounds.

Then again, in the past it was a trade maxim that Europe would buy an unlimited amount of copper at 12 to 12½ cents, the large consumers and traders there being willing to stock up with copper at that price for investment. Now it has become apparent that the improved world-wide demand for copper has changed the buying level of the foreigners from 12 to 14 cents and at the 14 cent price an almost unlimited volume of copper can be sold abroad.—News Letter.

American Mining Congress

The report of the proceedings of the American Mining Congress has just come to hand. It covers the results of the sixteenth annual session held at Philadelphia. The report includes a great many papers and subjects relating to mining and all of interest and value in the many phases of this great industry.

None of the officers, directors or executive committee are from Arizona, they are mainly from the iron and coal producing states.

The congress has increased in importance from year to year and is at present probably on a more important and useful basis as a help to mining than ever before. The congress is going to be especially effective in legislation relating to mining, for the heads are practical, and no doubt there is a great future for its work.

The Diamond

The Diamond is the most impenetrable of all known substances, and will scratch any other stone or the hardest steel. During his lecture at Kimberly, before the British association, Sir William Crookes squeezed a diamond between two blocks of steel until they touched, without the slightest injury to the stone although the pressure is said to have been 170 tons per square inch. Gardner P. Williams, late of the De Beers mines, witnessed the experiment, which thoroughly illustrated the impenetrability of a rounded diamond. No doubt, however, an octahedron formed stone would not have stood the test.

The De Beers diamond mines contribute \$3,600,000 per annum to the revenue of the union of South Africa, at the present rate of production, the mines will last for 50 years or more.—Mining & Scientific Press.

The Relation of Geology to Mining

(By E. H. Hatch, in Economic Geology) Geology was founded to a large extent on the observations of the miner. The primary geological conceptions, such as outcrop, strike, dip, hanging-wall and foot-wall, together with a wealth of mineralogical and petrological detail, were furnished by the early metal miner, while the close study of the bedding relations of the coal-seams, which their profitable extraction demanded, formed the basis of modern stratigraphy. The earlier geologists acknowledged their debt to mining, but today the positions are reversed, mining is in debt to geology. Thus, by the application of geological principles, valuable seams and lodes, even when distributed by igneous intrusions or dislocated by faulting, are traced beyond their first known outcrops, and facts bearing on their downward extension are scientifically interpreted. White detailed geological surveys of mining districts are of the greatest service to prospectors, and sometimes lead to entirely new discoveries. Today, on the great iron and copper mines of the United States not only are geologists retained to study the deposits, but the exploratory work is often committed to their care. By means of a system of routine work, successfully organized on some of these mines, veins and ore-shoots are correlated from level to level, raises, cross-cuts and pump stations are located in the positions most suitable to the geological conditions, and ore-bodies lost in faulted country are recovered, the fault displacement being determined quantitatively and allowed for in subsequent development work on lower levels.

Specific instances of the successful application of geological knowledge to mining work can, of course, be given in abundance; but a few must suffice for the present purpose.

In England, the proving of the un-

derground extension of the coal fields beneath the younger rocks surrounding them, is of paramount importance to its industrial welfare. One of the first pieces of work in this direction resulted from the admirable mapping of the Midland coal field by Beete Jukes, a distinguished member of the geological survey of England and Wales. The entire correctness of his theories was demonstrated by Henry Johnson in a deep sinking at Landwell Park, when the first definite proof was furnished of the prolongation of the South Staffordshire coal field to the east under the fringe of overlying red rocks.

Similarly, the discovery of a buried coal field in the southeast of England was the direct result of a piece of pure scientific deduction. Goodwin-Austen argued that the tectonic folds in the Palaeozoic floor, by which the existence of coal basins are determined, would be traceable, even when covered by a great thickness of newer rocks; because a line of disturbance, whether of faulting or folding, when once established, tends to be the locus of subsequent movements and thus to set its marks on newer strata.

The correctness of this tectonic principle was demonstrated by the successful borings carried out in the neighborhood of Dover, first by Sir Edward Watkin, and later by the Barr companies under the scientific advice of Professor W. Poyd Dawkins and other geologists. These borings showed that deeply buried under the mesozoic and tertiary strata, is a coal field, situated on the line connecting the seams worked in northern France and Belgium with those of south Wales and Bristol; and it appears not improbable that other coal areas might be found if the underground geology of this line of country were systematically explored.

A satisfactory feature of the discovery of buried coal fields in England is the large addition thereby made to British coal resources, as to which previous estimates had been rather pessimistic.

Another instance of the successful application of geology to mining is furnished by the tracing eastward and southward of the sub-outcrop or apex of the Rand bank formation under a cover of up to 1,200 feet of later unconformable beds. The investigation that led to this result were based on a geological survey of the country between Rockburg, the Springs and Heidelberg, the first results of which made it probable to me that the Van Ryn conglomerate, which disappears near the Springs beneath the Karoo coal measures and the Nigel conglomerate emerging therefrom near Heidelberg, were geologically identical, although separated by a large area in which dolomite and coal measures, the surface, as my work progressed, the position that the two outcrops, with their opposed dips, were respectively the northern and southern lips of a large but shallow synclinal basin, became almost a certainty, and deep borings made in the intervening country, confirmed in the end the correctness of the theory in the most satisfactory manner.

The successful outcome of these investigations, added to the Witwatersrand gold field, an enormous area of mining ground, in which the blanket is not too deep for exploitation, should its average gold content prove high enough to enable it to be profitably extracted, a consummation, of course, devoutly to be wished, but only demonstrable by sinking and development, since assay results of bore-hole cores are no guide to average values. The deepest bore hole of the series under my immediate supervision, namely, that put down on the boundary of the farms Grootvlei and Daggafontein, was practically on the axis of the syncline and cut the main reef at a depth of 5,540 feet. It passed through 1,140 feet of dolomite before entering the Witwatersrand formation, but gave a most instructive section of the latter, intersecting the Kimberley, Bird, Modderfontein and Van Ryn main reef series of conglomerates and their associated quartzites, slates and sheets of amygdaloidal diabase. At the time of boring the whole of the core, about a mile in length, was carefully labeled and preserved on the property in a specially constructed core house.

The limited time at my disposal will not allow me to recapitulate more than a few of the important services rendered in recent years to mining by geologists. But mention must be made of E. J. Dunn's survey of the Bendigo gold fields and his brilliant exposition of the true nature of the remarkable saddle reefs, whose tectonic structure has determined a type of mine development quite peculiar to that field.

Again, S. F. Emmons' monograph on the structure and genesis of the Leadville silver-lode ore has been of enormous value to the Colorado mines, not a few of whom owe their success in that field to the predictions of the distinguished economic geologist, whose recent demise we must all deplore; on the other hand, the theory advocated by Emmons, that the ores were derived from materials leached from the overlying porphyries, and the consequent conclusion that the lower or white limestone would prove unproductive have probably somewhat retarded the deeper development of the district. These lower horizons have since proved to be very productive, as will be shown in the new monograph on the Leadville district, now in preparation by the United States geological survey. Emmons' researches on the deposits of silver-lead ore in limestone at Leadville incidentally led him to develop the theory of metasomatism, or replacement, as a prime factor in the genesis of ore deposits.

Another worker in the same field, and moreover a friend of Emmons', and long a colleague on the United States geological survey, is George F. Becker, whose classical studies on the famous Comstock lode and its high temperature thermal springs, have done so much to demonstrate the close genetic connection between ore deposits and volcanic action. Becker's monograph on the geology of the Comstock lode was issued in 1882, and in one of the opening chapters he pays a remarkable trib-

ute to Baron Ferdinand von Richthofen, who examined the Comstock in 1885 for the Surtout Tunnel company, at that time engaged in driving a deep level add to the lode at a depth of over 1,000 feet vertical below the then existing workings. The German geologist had a keen insight into structure, and although the mines were, when Becker wrote, about six times as deep as they were at the date of von Richthofen's report, the later investigation states that the opinions and predictions of his predecessor as to the behaviour of the lode in depth had been verified in a very remarkable manner.

Von Richthofen ascribed both the filling of the Comstock fissure and the decomposition of the andesite "country" on its hanging wall to solfataric action, a term he used to describe the alternative influence of the gases and water vapor given off from a late volcanic intrusion into the Comstock complex. Von Richthofen was evidently a strong supporter of Elie de Beaumont's theory of ore deposition by metallic emanations, Becker, on the other hand, although he recognized that the hot springs met with in the Comstock lode must owe their abnormal heat to the effects of an expiring vulcanism, the focus of which he placed at between two and four miles depth, considered these waters (to which he attributed both the filling of the fissure and the prophylitization of the andesites) to be of meteoric origin, tentatively suggesting the Sierra Nevada (distant twelve miles from the Comstock) as their source.

The United States not only is rich in great natural repositories of mineral wealth, but is fortunate in its economic geologists, whose keen observation and powers of deductive reasoning are admirably adapted to the study of their structure and genesis. That this is no idle saying, witness the splendid series of monographs and professional papers issued by the United States geological survey.

I have referred to the work of Emmons and Becker, but there are many others, to mention a few only: R. D. Irving, who wrote on the copper-bearing rocks of Lake Superior; Lindgren, on the copper deposits of the Clinton-Moynihan district of Arizona; Weed, on the geology and ore deposits of the Butte district, Montana; Lindgren and Ransome, on the geology and gold deposits of the Cripple Creek district, Colorado; Van Hise and Leitch, on the iron ore deposits of Lake Superior; Willett G. Miller's work in Canada, on the cobalt-silver district, also deserves

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characteristic features of the silver Structure of the Butte District, veins, right at the beginning of the ascending very detailed observations of that camp, was done.

of first importance, and his early "In every mine map of each level recognition of the bearing of the were transferred to note-books, and Kiewit series, which underlies the with these in hand, the writer and cobalt conglomerate, on the life of his assistants carefully examined the the mines, exercised a salutary drifts and cross-sections and plotted on chattering influence on the exchanger, the maps the occurrence of each silo, and optimism of those responsible vein or fault, noting the dips, strikes for the primary development of the and raises were noted in the same field.

The liberious nature of the task was and sketches made of particular of collecting and collating the mate-features of vein-structure and oreral for such memoirs is well illustrated by the introductory remarks. Over a hundred miles of under- to Mr. Weed's professional paper, around workings were examined in "The Complexity of the Geological this manner."

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